00 Rec'd PCT/PTO 03 MAY 2000

FORM PTO-1390 (Modified) (REV 10-95) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER: 2867-0188-2 PCT

# TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR): 09/529427

| INTERNATIONAL APPLICATION NO. | INTERNATIONAL FILING DATE | PRIORITY DATE CLAIMED |
|---|---|---|
| PCT/SE98/01931 | 27 OCTOBER 1998 | 03 NOVEMBER 1997 |

TITLE OF INVENTION
**IMPROVEMENTS IN, OR RELATING TO, NEAR-ECHO SUPPRESSION**

APPLICANT(S) FOR DO/EO/US
**Gunnar BAHLENBERG, et al.**

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☒ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ A copy of the International Search Report (PCT/ISA/210).
8. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
10. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

**Items 13 to 18 below concern document(s) or information included:**

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
    A **SECOND** or **SUBSEQUENT** preliminary amendment.
16. ☐ A substitute specification.
17. ☐ A change of power of attorney and/or address letter.
18. ☐ Certificate of Mailing by Express Mail
19. ☒ Other items or information:

**Request for Consideration of Documents Cited in International Search Report**
**Notice of Priority**
**PCT/IB/304**
**PCT/IB/308**

| U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR 09/529427) | INTERNATIONAL APPLICATION NO. PCT/SE98/01931 | ATTORNEY'S DOCKET NUMBER 2867-0188-2 PCT |
|---|---|---|

20. The following fees are submitted:.

| BASIC NATIONAL FEE ( 37 CFR 1.492 (a) (1) - (5)) : | | CALCULATIONS PTO USE ONLY |
|---|---|---|
| ☐ Search Report has been prepared by the EPO or JPO . . . . . | $840.00 | |
| ☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) . . . . . | $670.00 | |
| ☐ No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) . . . . . | $760.00 | |
| ☒ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2) paid to USPTO . . . . . | $970.00 | |
| ☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) . . . . . | $96.00 | |
| **ENTER APPROPRIATE BASIC FEE AMOUNT =** | | $970.00 |
| Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☒ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)). | | $130.00 |

| CLAIMS | NUMBER FILED | NUMBER EXTRA | RATE | |
|---|---|---|---|---|
| Total claims | 16 - 20 = | 0 | x $18.00 | $0.00 |
| Independent claims | 1 - 3 = | 0 | x $78.00 | $0.00 |
| Multiple Dependent Claims **(check if applicable)**. | | | ☐ | $0.00 |
| **TOTAL OF ABOVE CALCULATIONS** | | | = | $1,100.00 |
| Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) **(check if applicable)**. | | | ☐ | $0.00 |
| **SUBTOTAL** | | | = | $1,100.00 |
| Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). | | | + | $0.00 |
| **TOTAL NATIONAL FEE** | | | = | $1,100.00 |
| Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).** | | | ☐ | $0.00 |
| **TOTAL FEES ENCLOSED** | | | = | $1,100.00 |
| | | | | **Amount to be: refunded** $ |
| | | | | **charged** $ |

☒ A check in the amount of **$1,100.00** to cover the above fees is enclosed.

☐ Please charge my Deposit Account No. in the amount of to cover the above fees.
A duplicate copy of this sheet is enclosed.

☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. **15-0030** A duplicate copy of this sheet is enclosed.

**NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.**

SEND ALL CORRESPONDENCE TO:

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REGISTRATION NUMBER

May 3, 2000
DATE

2867-188-2 PCT

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF: :

GUNNAR BAHLENBERG ET AL : ATTN: APPLICATION DIVISION

SERIAL NO: NEW U.S. PCT APPLICATION :
(Based on PCT/SE98/01931)

FILED: HEREWITH : EXAMINER:

FOR: IMPROVEMENTS IN, OR :
RELATING TO, NEAR-ECHO
SUPPRESSION

PRELIMINARY AMENDMENT

ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C. 20231

SIR:

Prior to a first examination on the merits, please amend the above-identified application as follows:

IN THE SPECIFICATION

Page 1, before line 1, insert:

--TITLE OF THE INVENTION--;

between lines 1 and 2, insert:

--BACKGROUND OF THE INVENTION

Field of the Invention--;

between lines 4 and 5, insert:

--Discussion of the Background--;

between lines 16 and 17, insert:

--SUMMARY OF THE INVENTION--.

Page 2, between lines 18 and 19, insert:

BRIEF DESCRIPTION OF THE DRAWINGS--.

Page 3, before line 1, insert:

--DESCRIPTION OF THE PREFERRED EMBODIMENTS--.

IN THE CLAIMS

Please amend the claims as follows:

Claim 3, line 1, delete "either"; same line, delete "or claim 2,".

Claim 4, line 1, delete "any previous"; same line, after "claim" insert --1--.

Claim 6, line 1, delete "either"; same line, delete "or 5,".

Claim 7, lines 2-3, change "any of claims 1 to 6" to --claim 1--.

Please add new Claims 8-16 as follows:

--8. A hybrid circuit, as claimed in claim 2, characterized in that said hybrid circuit is adapted to operate with a transmission system employing OFDD, and in that said filter is dimensioned to reject transmit sub-carriers originating from said D/A convertor.

9. A hybrid circuit as claimed in claim 2, characterized in that said hybrid circuit is adapted to operate with a duplex system having the following characteristics:

all transmitter in ONUs and NTs in said duplex system are time synchronized;

timing advance is calculated from line lengths;

different sub-carriers are employed for up-stream and down-stream transmissions;

a cyclic prefix is added to compensate for delay propagation in transmission lines; and

frequencies above the FDD band are not employed for longer lines.

10. A hybrid circuit as claimed in claim 3, characterized in that said hybrid circuit is adapted to operate with a duplex system having the following characteristics:

all transmitter in ONUs and NTs in said duplex system are time synchronized;

timing advance is calculated from line lengths;

different sub-carriers are employed for up-stream and down-stream transmissions;

a cyclic prefix is added to compensate for delay propagation in transmission lines; and

frequencies above the FDD band are not employed for longer lines.

11. A hybrid circuit, as claimed in claim 5, characterized in that said balanced hybrid and said filter, together, introduce a delay less than a delay for which said cyclic prefix is dimensioned.

12. A duplex transmission system characterized in that said duplex transmission system includes a plurality of hybrid circuits as claimed in claim 2.

13. A duplex transmission system characterized in that said duplex transmission system includes a plurality of hybrid circuits as claimed in claim 3.

14. A duplex transmission system characterized in that said duplex transmission system includes a plurality of hybrid circuits as claimed in claim 4.

15. A duplex transmission system characterized in that said duplex transmission system includes a plurality of hybrid circuits as claimed in claim 5.

16. A duplex transmission system characterized in that said duplex transmission system includes a plurality of hybrid circuits as claimed in claim 6.--

REMARKS

Favorable consideration of this application, as presently amended, is respectfully requested.

The present preliminary amendment is submitted to place the above-identified application in more proper format under United States practice. By the present preliminary amendment the specification has been amended to include suggested headings. The claims have also been amended to no longer recite any multiple dependencies. The subject matter of the cancelled multiple dependencies is also now submitted in new Claims 8-16.

The present application is believed to be in condition for a full and thorough examination on the merits. An early and favorable consideration of the present application is hereby respectfully requested.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
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## Improvements in, or Relating to, Near-Echo Suppression

The present invention relates to a hybrid circuit for 2-wire to 4-wire conversion in which near-echo is substantially reduced for short lines and to a duplex transmission system employing a plurality of said hybrids.

Hybrid balancing has been used for many years to make 4-wire to 2-wire conversions, and vice versa, for duplex systems using a single line. If the balance is less than ideal, a portion of the transmitted signal will leak through the hybrid into the received signal path. This is referred to as near-echo. If the near-echo is strong, compared to the received signal, more bits are required in an Analogue to Digital (A/D) convertor located in the receive path. The present invention relates to a technique for substantially suppressing near-echo before A/D conversion in 2-ware to 4-wire hybrid circuit.

A hybrid circuit, of the type to which the present invention relates, may be used with the invention described in our co-pending patent application Kgp 152/97, which relates to the application of the present invention to extending the reach of a VDSL.

According to a first aspect of the present invention, there is provided a hybrid circuit having a balanced 2-wire to 4-wire hybrid for interconnecting a two wire receive path and a two wire transmit path to a two wire transmission line, said two wire receive path connecting the balanced hybrid to an A/D convertor and said two wire transmit path connecting a D/A convertor to said balanced hybrid, characterised in that said two wire receive path contains a filter.

Said hybrid circuit may be adapted to operate with a transmission system employing FDD, and said filter may be dimensioned to reject transmit signals originating from said D/A convertor.

Said hybrid circuit may be adapted to operate with a transmission system employing OFDD, and said filter may be dimensioned to reject transmit sub-carriers

originating from said D/A convertor.

Said hybrid circuit may be adapted to operate with a duplex system having the following characteristics:

- all transmitters in ONUs and NTs in said duplex system are time synchronised;
- timing advance is calculated from line lengths;
- different sub-carriers are employed for up-stream and down-stream transmissions;
- a cyclic prefix is added to compensate for delay propagation in transmission lines; and
- frequencies above the FDD band are not employed for longer lines.

Said cyclic prefix may be dimensioned for lines of length X metres and OFDD is used for lines shorter than X metres.

Said balanced hybrid and said filter, together, may introduce a delay less than a delay for which said cyclic prefix is dimensioned.

According to a second aspect of the present invention, there is provided a duplex transmission system, characterised in that said duplex transmission system includes a plurality of hybrid circuits as described in any previous paragraph.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 illustrates, in schematic form, a hybrid circuit according to the present invention.

In order to facilitate an understanding of the present invention a glossary of terms used in the description of the present invention is provided below:

| | |
|---|---|
| A/D: | Analogue to Digital |
| ADC: | Analogue to Digital Convertor |
| D/A: | Digital to Analogue |
| DAC: | Digital to Analogue Convertor |
| DMT: | Discrete Multi Tone |
| FDD: | Frequency Divided Duplex |
| NT: | Network Termination |
| OFDD: | Orthogonal Frequency Divided Duplex |
| ONU: | Optical Network Unit |
| VDSL: | Very high rate Digital Subscriber Line |

Where an A/D convertor is located in the receive arm of a hybrid circuit, as illustrated in Figure 1, the number of bits required in the A/D convertor is determined from the input signal level. If the signal level is increased there will be a loss of resolution when the dynamic range is kept the same. If the near-echo is as strong as the received signal, the A/D convertor will require one extra bit to maintain the same resolution. For long lines, the received signal will be more attenuated than for shorter lines. The near-echo will not be affected by the line length. This means that longer lines will be more affected by the near-echo signal.

The present invention is particularly applicable to reducing near-echo signal

for the duplex scheme described in our co-pending patent application Kgp 152/97, and DMT symmetric transmission systems of the type described in our patent application PCT/SE 9600935. The basic concept presented in our co-pending application, Kgp 152/97, is the use of Frequency Divided Duplex (FDD) for transmission at lower frequencies and Orthogonal Frequency Divided Duplex (OFDD), also known as Zipper, for transmission at higher frequencies. For long lines only, FDD is used for the lower frequencies (FDD). For short lines, an arbitrary up-/down-stream loading is possible for the higher frequencies. The key elements in the duplex scheme are:

- performance of time synchronisation between all transmitters in the ONU and the NTs;
- calculation of timing advance from the line length;
- use of different sub-carriers in up- and down-stream directions;
- addition of an extension of the cyclic prefix to compensate for delay propagation in the line - this extra cyclic prefix is dimensioned for X metres, where X is the length of the shorter line; and
- not using the frequencies above the FDD band for lines longer than X metres, which means that FDD is used for longer lines and that OFDD can be used for lines less than X m.

To suppress the near-echo signal before A/D conversion, a filter is inserted, see Figure 1. This filter removes the transmitted signal in the FDD band described in our co-pending application Kgp 152/97, in which, where FDD is employed, different frequency bands are used for up- and down-stream bands. This enables filters to be used to separate up-stream bands from down-stream bands. For the ONU side, it will be the FDD downstream band that is filtered out and, for the NT side, it will be the FDD upstream band that is removed.

For long lines, where only the lower frequencies are used, i.e. FDD is

employed, there is almost no near-echo because of the filter. For shorter lines, where higher frequencies are used, near-echo will be reduced. Suppressing near-echo is more important for long lines where the received signal is more attenuated. To fulfil the orthogonality requirements, the delay of the hybrid plus the filter must be less than the delay for which the extra cyclic prefix is dimensioned.

By using the present invention:

- the number of bits required in the A/D converter, when OFDD is used, is reduced; and

- for longer lines, near-echo is better suppressed.

For the avoidance of doubt the term OFDD, as used in this specification, is intended to embrace similar duplex techniques, such as those employing DMT, wavelet multiplexing, or the like.

## CLAIMS

1. A hybrid circuit having a balanced 2-wire to 4-wire hybrid for interconnecting a two wire receive path and a two wire transmit path to a two wire transmission line, said two wire receive path connecting the balanced hybrid to an A/D convertor and said two wire transmit path connecting a D/A convertor to said balanced hybrid, and said two wire receive path contains a filter, characterised in that said hybrid circuit is adapted to operate with a transmission system employing FDD at low freequences, and said filter is dimensioned to reject transmit signals originating from said D/A convertor, that said hybrid circuit is adapted to operate with a transmission system employing OFDD at high freequences, and in that said filter is dimensioned to reject transmit sub-carriers originating from said D/A convertor.

2. A hybrid circuit as claimed in claim 1, characterised in that said hybrid circuit is adapted to operate with a duplex system having the following characteristics:

- all transmitters in ONUs and NTs in said duplex system are time synchronised;
- timing advance is calculated from line lengths;
- different sub-carriers are employed for up-stream and down-stream transmissions;
- a cyclic prefix is added to compensate for delay propagation in transmission lines; and
- frequencies above the FDD band are not employed for longer lines.

3. A hybrid circuit as claimed in claim 2, characterised in that said cyclic prefix is dimensioned for lines of length X metres and OFDD is used for lines shorter than X metres.

4. A hybrid circuit, as claimed in either claim 2, or 3, characterised in that said balanced hybrid and said filter, together, introduce a delay less than a delay for which said cyclic prefix is dimensioned.

5. A duplex transmission system, characterised in that said duplex transmission system includes a plurality of hybrid circuits as claimed in any of claims 1 to 4.

FIGURE1

# Declaration, Power Of Attorney and Petition



WE (I) the undersigned inventor(s), hereby declare(s) that:

My residence, post office address and citizenship are as stated below next to my name,

We (I) believe that we are (I am) the original, first, and joint (sole) inventor(s) of the subject matter which is claimed and for which a patent is sought on the invention entitled

IMPROVEMENTS IN, OR RELATING TO, NEAR-ECHO SUPPRESSION

the specification of which

☐ is attached hereto.

☒ was filed on May 3, 2000 as
Application Serial No. 09/529,427
and amended on _____.

☒ was filed as PCT international application
Number PCT/SE98/01931
on October 27, 1998,
and was amended under PCT Article 19
on _____ (if applicable).

We (I) hereby state that we (I) have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

We (I) acknowledge the duty to disclose information known to be material to the patentability of this application as defined in Section 1.56 of Title 37 Code of Federal Regulations.

We (I) hereby claim foreign priority benefits under 35 U.S.C. § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed. Prior Foreign Application(s)

| Application No. | Country | Day/Month/Year | Priority Claimed |
|---|---|---|---|
| 9704010-9 | SWEDEN | 3 November 1997 | ☒ Yes ☐ No |
| | | | ☐ Yes ☐ No |
| | | | ☐ Yes ☐ No |
| | | | ☐ Yes ☐ No |

We (I) hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below.

(Application Number) (Filing Date)

(Application Number) (Filing Date)

We (I) hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s), or § 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

| Application Serial No. | Filing Date | Status (pending, patented, abandoned) |
|---|---|---|
| PCT/SE98/01931 | 27 October 1998 | |
| | | |
| | | |

And we (I) hereby appoint: Norman F. Oblon, Reg. No. 24,618; Marvin J. Spivak, Reg. No. 24,913; C. Irvin McClelland, Reg. No. 21,124; Gregory J. Maier, Reg. No. 25,599; Arthur I. Neustadt, Reg. No. 24,854; Richard D. Kelly, Reg. No. 27,757; James D. Hamilton, Reg. No. 28,421; Eckhard H. Kuesters, Reg. No. 28,870; Robert T. Pous, Reg. No. 29,099; Charles L. Gholz, Reg. No. 26,395; William E. Beaumont, Reg. No. 30,996; Jean-Paul Lavalleye, Reg. No. 31,451; Stephen G. Baxter, Reg. No. 32,884; Richard L. Treanor, Reg. No. 36,379; Steven P. Weihrouch, Reg. No. 32,829; John T. Goolkasian, Reg. No. 26,142; Richard L. Chinn, Reg. No. 34,305; Steven E. Lipman, Reg. No. 30,011; Carl E. Schlier, Reg. No. 34,426; James J. Kulbaski, Reg. No. 34,648; Richard A. Neifeld, Reg. No. 35,299; J. Derek Mason, Reg. No. 35,270; Surinder Sachar, Reg. No. 34,423; Christina M. Gadiano, Reg. No. 37,628; Jeffrey B. McIntyre, Reg. No. 36,867; William T. Enos, Reg. No. 33,128; Michael E. McCabe, Jr., Reg. No. 37,182; Bradley D. Lytle, Reg. No. 40,073; and Michael R. Casey, Reg. No. 40,294; our (my) attorneys, with full powers of substitution and revocation, to prosecute this application and to transact all business in the Patent Office connected therewith; and we (I) hereby request that all correspondence regarding this application be sent to the firm of OBLON, SPIVAK, McCLELLAND, MAIER & NEUSTADT, P.C., whose Post Office Address is: Fourth Floor, 1755 Jefferson Davis Highway, Arlington, Virginia 22202.

We (I) declare that all statements made herein of our (my) own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

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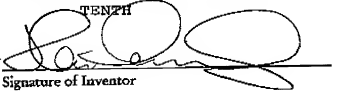

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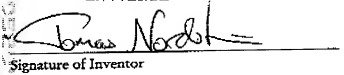

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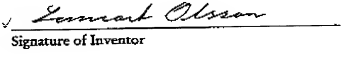

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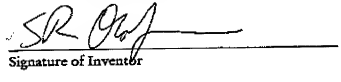
Sven-Rune ~~OLOFSSON~~
NAME OF ~~NINTH~~ THIRTEENTH JOINT INVENTOR



Signature of Inventor

2000-08-14
Date

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Per ODLING
NAME OF ~~NINTH~~ JOINT INVENTOR
SEVENTEENTH

Signature of Inventor

2000-09-25
Date

OLD!
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PL 680C LAKASUND, S-89196 ARNÄSVALL, SWEDEN, 23 October 2000, P.O.
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2000-07-31
Date

NAME OF EIGHTH JOINT INVENTOR

Residence:

Signature of Inventor

Citizen of:

Post Office Address:

Date

NAME OF NINTH JOINT INVENTOR

Residence:

Signature of Inventor

Citizen of:

Post Office Address:

Date